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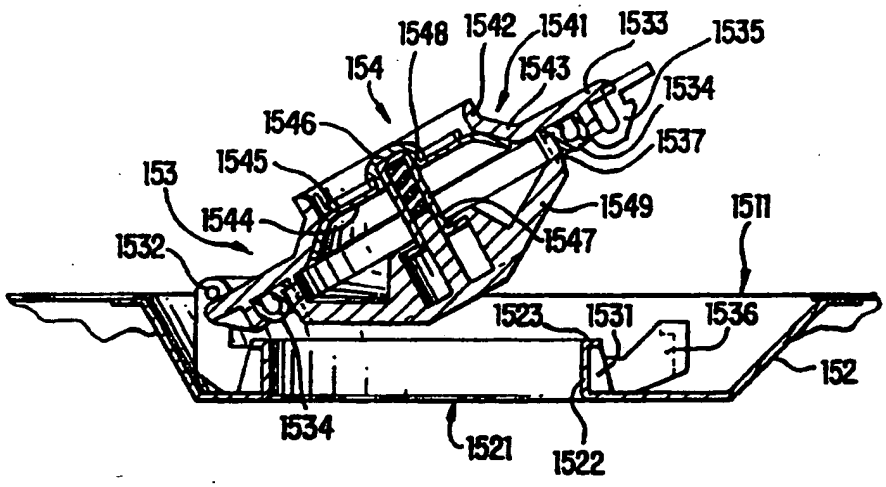

(57) Abstract

A portable, inflatable support system, and a portable inflator for use with such a system are provided in one embodiment. The inflatable support system may include an inflatable mattress (10) having a pressure valve (12) and a battery powered inflator (20) for removable engagement therewith, which on engagement is automatically powered for a predetermined time or until a predetermined pressure is achieved. The mattress (10) may be readily expanded for use and collapsed for storage. Another embodiment provides a multipurpose pressure control, for manual adjustment to provide an inflatable support system of desired firmness, and to modify the posture of the reclining user. A dual valve assembly (12) includes a cover assembly (153) that removably covers a throat, and the cover assembly (153) is itself provided with a one-way valve (154). Another embodiment provides an in-place bedding system, including a mattress (10), mattress cover (81), and top and bottom bedsheets, which retain their functional arrangement when the bed is collapsed for storage and prepared for use, thereby eliminating the necessity for re-making the bed with each use.

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embodiment of the invention. The inflation device includes a dc motor 25, powered by rechargeable batteries 22a and 22b, and an impeller 21 driven by the motor 25, all mounted in a housing 26 having a mouth region 28 that is removably engagable with the inflation input (discussed below in connection with Fig. 3 as item 322) of the dual valve 12. The method of engagement may be by screw threads 27 or by other suitable means known in the art, such as a bayonet mount permitting quick connection and disconnect. Also disposed in the housing 26 are control circuitry for controlling the motor, sensing arrangement 24 for sensing when the mouth 26 of the housing is engaged with the inflation input of the dual valve 12, and dc battery recharging input 29. The housing 26 may also be provided with a suitable arrangement for covering the mouth region 28 and the air inlet 281. Although numerous such arrangements are possible, one arrangement may include a snap-on C-shaped clip that is pivotally mounted along a vertical axis of the inflation device 20 of Fig. 2 to permit the clip to swing off the mouth 28 and the air inlet 281. The control circuitry 23 is connected to the batteries 22a and 22b over lines 231 and 233 respectively, to the motor 25 over line 232, to the sensing arrangement 24 over line 234, and to the recharging input 29 over line 235. The sensing arrangement may be a simple contact switch, mounted in the mouth 28, that is closed by motion of the threads of the inflation input when it is engaged with the mouth 28. Alternatively, for example, the sensing arrangement may be a Hall effect device mounted in the mouth 28 that is triggered by proximity to a magnet mounted in the inflation input.

The control circuitry 23 is configured, by means well known in the art, to deliver power to the motor 25 from the time that the sensing arrangement 24 has detected engagement of the mouth 26 with the inflation input of the dual valve 12. In this manner, pumping of air into the mattress begins only after, and as soon as, the inflation device 20 has been properly engaged. Similarly, the control circuitry is

configured to cease delivering power when the inflation device 20 is no longer engaged, so that it may be asily turned on and off without the need for an external switch. When the inflation device 20 is engaged with the mattress, the control circuitry 23 continues to deliver power to the motor 25 until a predetermined condition has been achieved. In one version of this embodiment, the battery-motor-impeller combination is designed to provide a maximum air pressure that does not exceed the maximum desired pressure in the mattress. In such a case, for a mattress of a given size, once a predetermined time has elapsed for delivery of air to the mattress by the inflation device 20, the maximum desired pressure will have been reached.

Accordingly, the control circuitry is designed to cease delivering power to the motor 25 when a predetermined time has elapsed after the sensing arrangement 24 has sensed engagement of the mouth 26 with the inflation input of the dual valve 12. With a typical air mattress and a typical design for an inflation device, for example, maximum pressure may be achieved in about one minute, so the control circuitry provides a timed shutoff after one minute. It is apparent that the timed shut-off feature provides desirable conservation of battery power, and conservation may be enhanced if shut-off occurs at full inflation--i.e. when the inflation device has first achieved the maximum pressure in the air mattress of which it is capable, assuming that this maximum does not exceed the maximum desired pressure in the mattress. Indeed, such an approach permits use of a relatively small and lightweight inflation device. If the user is prepared to provide manually (i.e., by blowing) the final bolus of air to achieve the desired pressure, the inflation device may be smaller still. Such a design spares the user of the time-consuming and headache-producing task of filling the mattress manually, while permitting a compact and lightweight construction for the inflation device 20.

Alternatively, the control may take advantage of the fact that air flow from the inflation device 20 to the

inflation input of the dual valve 12 has substantially ceased when the maximum desired pressure has been reached, assuming that the battery-motor-impeller combination is designed to provide a maximum air pressure that does not exceed the maximum pressure in the mattress. In this alternative configuration, the inflation device 20 may be further provided with a flow sensor, and the control circuitry 23 may be configured to cease delivering power after substantial air flow has ceased. The flow sensor in such a configuration may be implemented by a vane (shown in phantom) 201 mounted on a pivot 202 and having an arm 203 that keeps a normally open microswitch (shown in phantom) 204 closed only as long as air flow is substantial, and the microswitch is connected to the control circuitry 23 over line 236. The control circuitry 23 is then configured to provide initial power to the motor 25 independently of the position of microswitch 204 until a period of time has elapsed to permit the establishment of initial flow to cause closure of the microswitch.

In a related alternative embodiment of the device 20 shown in Fig. 2, there may be provided a pressure transducer that is connected to the control circuitry 23, which may be configured to cease providing power to the motor 25 after a predetermined pressure has been reached.

Figs. 3 and 4 show a cross section and a top view respectively of the dual valve assembly depicted in Fig. 2. This valve assembly is similar to the valve assembly shown in Figs. 11-13 of my prior United States application serial number 07/557,943, filed July 25, 1990.

Inflation is provided to the mattress 10 by means of the inflation input 322 having exterior threads 321, which are capable of being engaged with mating threads of the inflation device 20 described above. As previously discussed, the means of achieving the engagement with the inflation device is a matter of design choice, and alt rnative embodiments, such as the use of a bayonet mount, are within the scope of the present invention. Air pressure

at the inflation input 322 causes the downward displacement of diaphragm 34 away from its valve seat 36, thereby permitting air flow through the first cylinder 32 via the triangular passageways 37. When air has been placed within the mattress 10 under modest pressure, however, and air pressure is removed from inflation input 322, the pressure of air in the mattress 10 urges the diaphragm 34 against valve seat 36 and produces a positive seal against the exit of air from the mattress. An optional spring 311 may be used to assure a positive seal even in the absence of substantial pressure within the mattress 10. This seal can be momentarily overridden by pressing downwardly on stem 31, which causes the downward motion of the diaphragm away from the valve seat 36, and permitting the exit of controlled amounts of air through the passageways 37. Thus the valve design permits the reduction of air pressure in the mattress from any excess that may have occurred on inflation to a desired optimum pressure, simply by pressing on the stem 31. The quality of air released by the valve may be controlled by the distance the valve stem 31 is initially depressed (letting air pressure within the mattress 10 force the valve to return to a closed position); for example, a one-eighth inch depression provides a subtle decrease in pressure and a one-half inch depression a more substantial pressure drop. It should be pointed out that the valve described herein typically functions over a pressure range from approximately 1/4 to 1 lb of pressure per square inch (2 to 7 kPa), a region in which it is typically difficult to achieve good control simultaneously with an effective seal. The diameter of first cylinder 32 is large enough (typically about 1.25 inches (3 cm) or more) to permit the rapid inflation of the mattress with a substantial flow of air at relatively low pressure.

The valve assembly just described, including first cylinder 32, diaphragm 34, and stem 31, is mounted concentrically within a s cond cylinder 33, and is itself hingedly mounted so as to cover the opening of the second

cylinder 33. The opening is defined by rim 38, and against which is mated cov r seal 39. The hinge pivot 35 permits the valve assembly to uncover the opening 33, which is large enough to permit the rapid and easy deflation of the mattress by expelling air through the opening of cylinder 33, which is typically about 2 inches (5 cm) or more. The opening of the cylinder 33 is sealed when the mattress is in use by latch 36, which is disposed on the opposite side of the assembly from pivot 35, and causes rim 38 to be hugged by cover seal 39. Although the embodiment illustrated herein shows the use of a hinge 35 and a latch 36, it may be seen that the valve assembly described previously may be secured to cover the second cylinder 33 by other means known in the art, including a bayonet mount that is secured after engagement by rotation. Alternatively there may be employed a combination bayonet-hinge assembly, configured so that after the bayonet is disengaged by counter-rotation, a pivot (similar to item 35, but carried on a short arcuate track mounted to the second cylinder so as to permit rotation of the bayonet) permits the valve assembly to uncover the opening defined by rim 38 in a manner similar to that described above.

In order to permit unrestricted air flow into (or out of) the air mattress when it is in a collapsed or near-collapsed condition, the housing for the second cylinder is provided with a plurality of stand-offs 331 that prevent the inner surface of mattress 10 from fully occluding the opening of the second cylinder 33 to the mattress interior. Similarly, a series of openings 323 in the inner extremity of the first cylinder 32 prevent the inner surface of mattress 10 from fully occluding the opening of the first cylinder to the mattress interior.

Figs. 5 through 7 illustrate another preferred embodiment of the invention, in this case providing a multipurpose pressure control. Fig. 5 is a side view of the embodiment with the mattress 10 moved out of the way. Fig. 6 is a vertical section taken through plane VI-VI of Fig. 5,

and Fig. 7 is a top view of the embodiment of Fig. 5. In this embodiment, in a manner similar to that of the embodiment of Fig. 1 of United States application serial number 07/557,943, filed July 25, 1990, a housing 57 contains a line-powered motor-driven fan to pump air into the mattress 10 and also serves as a mandrel upon which the deflated mattress may be wound; a large diameter valve at the foot of the mattress (not shown in these figures) may provide rapid deflation of the mattress. Power is supplied via plug 53, line cord 54 and a switch contained in assembly 51. Region 55 of the housing 57 contains a motor and fan to provide air pressure to inflate the mattress 10. The motor and fan may be designed, as described above, in connection with Fig. 2, to provide a maximum air pressure that does not exceed the maximum desired pressure in the mattress and may employ control circuitry of the type described above to turn off the motor once a desired pressure has been reached. Region 56 of the housing contains a one-way valve, similar to the valve assembly associated with the first cylinder 32 described in relation to Figs. 3 and 4 above. Recessed in the top of switch assembly 51 is switch button 511 for turning on the fan motor. Normally switch assembly 51 is unmounted and moves freely as part of line cord 54. Thus, when the unit is plugged in and the switch in assembly 51 is turned on, the mattress is inflated and unwinds from the housing 57. After the mattress is inflated, the switch assembly 51 may then be placed in removable engagement with receptacle 58 on housing 57.

Receptacle 58 is formed on a flexible membrane forming at this point the exterior of housing 57 and disposed over stem 61 (corresponding to stem 31 of Fig. 3) associated with diaphragm 62 (corresponding to diaphragm 34 of Fig. 3). The walls of cylinder 63 (corresponding to cylinder 32 of Fig. 3) are attached on the outside to air mattress 10, and define an opening 64 through which air from the fan is pumped when the fan motor is energized. The housing 57 is removably engaged with the walls of cylinder 63, permitting

replacement of the air mattress 10 or motor fan unit if one of them fails.

It can be s en that pressing button 511 causes the fan motor to run and increases pressure in the mattress. Similarly, moving the entire assembly 51 in a downward direction causes force to be transmitted, through rod 64 and walls 52 of the assembly 51, and the flexible membrane of receptacle 58, to the stem 61 of the valve, causing diaphragm 62 to let air out of the mattress. This embodiment therefore provides an easily operable multipurpose pressure control that in a first position causes air pressure in the mattress to increase and in a second position causes air pressure in the mattress to decrease. Because the housing 57 and related fittings are disposed at an end of the mattress 10, the control may be suitably located and reached at the head of the mattress, and is therefore accessible to a user while on the mattress. The multipurpose pressure control consequently permits the user to adjust the mattress air pressure for the user's personal comfort while on the mattress and without interruption of body contact with the mattress. As pressure adjustments may occur during the night, in darkness, with the user in a semi-awake, semi-conscious state, the control may be operated without vision, excessive manipulation, or major changes in posture. It should be noted that this embodiment permits both gross and subtle adjustments in mattress air pressure, thereby providing a sleep surface which accommodates a wide variety of comfort requirements. Additionally, in connection with embodiments, such as described in connection with Fig. 1 of my application serial number 07/557,943, filed July 25, 1990, wherein the motor-driven fan assembly lies at the head of the mattress, motion of assembly 51 can be used to partially deflate the mattress to permit the user to recline, while using the motor-driven fan assembly to support a pillow; such a position is comfortable for reading and the like. At low inflations, the mattress may still provide complete

suspension of the body, while also providing a difference in the range of 6-8 inches (15-20 cm) in elevation between feet and torso.

Although the embodiment described in connection with Figs. 5-7 uses a mixed mechanical and electrical system, it would be possible to use a control that is entirely actuated electronically, for example, employing a solenoid to move the valve stem 61 to open the diaphragm 62, and a three position switch that in a first position energizes the fan motor, in a second position energizes the solenoid, and in a third position energizes neither. Additionally, it is within the scope of the invention to provide a control that causes a predetermined increment of inflation or deflation in accordance with a user's selection. The increment may be determined, for example, by a timing device or a pressure measurement device.

The pneumatic support system of the present invention offers space-saving and time-saving advantages in comparison to prior art portable or temporary bed arrangements. In its fully expanded "in-use" state, the pneumatic support system herein occupies the same amount of space as a conventional mattress. Yet in a collapsed "storage" state, the support system returns almost 90% of that space to the user. In order for the user to fully realize the benefits of this advantage, the support system must allow the transition to and from storage to occur with maximum efficiency and ease. With the support system in accordance with the present invention, set-up and take-down require as little as 15 to 30 seconds.

In order to take full advantage of the utility offered by the support system in accordance with the present invention, a special bedding system is advantageous. When conventional covers and bedsheets are used with the present invention, they may become misaligned as it is being moved to and from storage, requiring that the support system be made over with bedding with each use. Since the movement in and out of storage may often occur on a daily basis,

considerable time and effort are l st through the requirement to re-make. The in-plac bedding system of the present invention eliminat s the problem of bedding misalignment.

Figs. 8-14 pertain to the in-place bedding system of the present invention. The in-pace bedding system includes a special mattress cover that permits use of a conventional fitted bottom bedsheet and a conventional top bedsheet, which will retain their functional relationships not only while in use, but also during and after the collapsing of support system for storage thereby eliminating the necessity for re-making the bed with each use.

The exterior of the mattress cover 81, shown in Fig. 8 in a top view, much like a fitted bedsheet, wraps around all four sides of the mattress. The cover assembly includes a padding material 82 sewn to the underside of the cover's top surface. This material may be foam rubber, synthetic fiber, a combination thereof, or other suitable material.

In Fig. 9 is shown a bottom view of the cover 81, which includes two cross-connectors 93 and 94 sewn to the bottom edges of the cover at positions 941 and 942 for connector 94 and 931 and 932 for connector 93. The cross-connectors 93 and 94 span the mattress bottom from side to side, securing the position of the mattress cover for multiple re-use (repeated cycles of inflation and deflation). On both sides of the cover, near the foot end, are sheet retainer rings 91 and 92, attached to the cover by elastic straps. These retainer rings, discussed in further detail in connection with Figs. 11-14, have the purpose of securing the position of a conventional top sheet for multiple re-use while, at the same time, allowing the flexibility and movement necessary for comfortable sleeping. Controller strap 91 runs around the inner periphery 99 of the cover 81 and is pulled and tightened in a manner known in the art to assure that the cover 81 tightly hugs the mattress. A pair of roll straps 95 are attached at one end to connector 93. When the mattress and mattress cover are rolled up as an assembled

unit (possibly using the h using of a motor-driven fan as a mandrel in the fashion describ d in connection with Fig. 5, and possibly including top and bottom bedsheets as described below), the other end of each of roll strap 95 may be passed through the open region 117 near the ear 111 (see Fig. 11) of a corresponding retaining ring 91 or 92 and thereafter attached to itself via Velcro or similar hook-and-loop type fastening material. In this way, the rolled up assembly may be maintained in a compact condition and easily readied for reuse in accordance with procedures described above. Fig. 10 is a perspective view from above of the general features described in connection with Fig. 9.

Initial set-up of the support system in accordance with Figs. 8-10 includes the following:

1. Insertion of the deflated mattress into the mattress cover 81.
2. Inflation of the mattress while checking for proper alignment of mattress and cover.
3. Installation of the bottom bedsheet (a standard fitted sheet).
4. Installation of the top bedsheet by laying it on the inflated bed and then drawing the two corners of the sheet through the bedsheet at its foot-end retainer rings 91 and 92, so that the bedsheet has a reasonably snug fit, conforming to the foot-end of the mattress.

Once these steps are taken, mattress, mattress cover, bottom bedsheet, and top bedsheet become a semi-permanent assembly, fixed in position for multiple re-use.

Detail of the retainer rings 91 and 92 is provided in Figs. 11-14. The retainer ring is a spring fastener, and may be fabricated from a variety of resilient materials including various plastics, such as polyethylene. Figs. 11 and 12 provide side and top views of the retainer ring,

which include slot 115 for attachment t the strap and ears 111 and 112. When ears 111 and 112 are squeezed toward one another, the peripheral wall 116 is deformed, as shown in Fig. 13 (also presenting a top view) and jaws 114 and 113 are caused to open, as shown in Fig. 14 (presenting a side view). Fig. 12 shows the region 121 wherein the teeth of the jaws 113 and 114 are engaged with one another when the ears are not squeezed together. In this embodiment, the peripheral wall, the jaws, and the ears are all formed as part of an integral structure.

Squeezing ears 111 and 112 toward one another allows insertion of the corner of the bedsheet through the jaws 114 and 113 of the ring. The top bedsheet corner may then be easily drawn though the ring to achieve proper fitting of the bedsheet to the bed. Once the sheet is in position (and the squeezing of the ears is released), the spring action of the ring applies pressure to the jaws and in turn on the inserted bedsheet portion, locking the inserted portion of the bedsheet in place, and securing the position of the sheet on the bed. For bedsheet removal, one merely squeezes together the ears 111 and 112 of the ring, and the bedsheet is automatically released.

The retainer ring provides convenience and ease in the use of conventional bedsheets for initially setting-up the bed, for changing bedsheets, and for providing a fixed bedding assembly that eliminates the need for re-making the bed with each use.

Although the foregoing embodiment has been described as a mattress cover, the essential features of the foregoing cover may be directly incorporated into the surface of the mattress. The padding material 82 may then be attached to the top surface of the mattress, provided with a suitable covering layer.

In Fig. 15 is shown a cross-section of a dual valve assembly that is an alternative to the embodiment depicted in Fig. 2. Fig. 16 shows the same assembly in cross-section with the cover assembly 153 in a closed position.

Fig. 17 is a top view of the embodiment of Figs. 15 and 16 with the cover assembly also in a closed position. In Fig. 18 is shown a top view of this same embodiment with the cover assembly in an open position. Fig. 19 is a cross-section of the same embodiment showing the air path through it during inflation.

In Fig. 15 the wall 151 of an inflatable body is shown to be provided with a port 1511 through which air is transferred between the exterior and the interior of the inflatable body. A flange 152 is mounted to the wall of the inflatable body in a location proximate to the port 1511. The flange 152 has a throat 1521 through which all air passes in the course of being transferred between the interior and exterior of the inflatable body. The throat 1521 is defined by a circular rim 1522 of the flange. A cover assembly 153 is used to removably cover the throat 1521. A ring-shaped base 1531 is disposed around the exterior of the rim 1522. Preferably the base is removable from the rim and is retained by top portion 1523 of the rim. Alternatively, the rim 1522 and the base 1531 may be integrally formed. Cap 1533 is attached to the base 1531 by means of hinge assembly 1532. The cap is latched into a closed position by a latching arrangement including latch projection 1535 on the cap and latch receptacle 1536 on the base. When the cap 1533 is closed, gasket 1534 is urged against the top 1523 of the rim 1522. In the closed position of the cap, the gasket 1534 is submitted to compression, and the gasket itself is formed of flexible material presenting, to the top of the rim, in profile a convex arcuate portion. The convex shape of the gasket 1534 may be achieved as shown here by use of a flexible sheet of material retained in an inverted U configuration or by use of a suitable O-shaped gasket.

It is convenient to make the flange 152 of flexible material. Under such circumstances, the rim 1522 may be subject to deformation, an eventuality that may interfere with an effective seal with the cover assembly 153. The

d f rmation may be reduced by integrally forming the rim 1522 with the bas 1531. Alt rnatively, it is convenient to provide a lip 1537, disposed peripherally around the cap, in such a way that, when the cap is in a closed position, the lip 1537 mates with the interior of the rim 1522. In this way, the flexible rim 1522 is squeezed between the lip 1537 and the base 1531, thereby reducing the risk of deformation of the rim.

Disposed in the cover assembly 153 is valve assembly 154. The valve assembly includes a diaphragm 1544 and valve stem 1547 that move axially in the assembly 154. The valve stem 1547 and diaphragm 1544 are supported by valve stem support 1549, which is attached to the cap 1533. The cap also includes the structure defining the inflation input 1542 and valve seat 1543 of the valve assembly 154.

A circular coupling 1541 includes an open end that constitutes the inflation input 1542. It also has a flared end that provides the valve seat 1543 in the form of a circular lip. Mounted adjacent to the diaphragm is diaphragm stiffener 1545, which serves to stiffen the diaphragm except in the outer annular region that is in contact with valve seat 1543.

It can be seen that the diaphragm can be accessed by an individual directly from the inflation input 1542 and can be pushed axially into an open position. Such a process is illustrated in Fig. 16. To facilitate this motion, the diaphragm is provided with push button 1546.

The diaphragm is urged into a closed position by spring 1548, shown here disposed within the valve 1547 and pushing against a portion of valve stem support 1549. As can be seen in Fig. 18, the valve stem support 1549 includes here four supporting members spaced around the assembly, but permits the ready passage of air through the throat.

As shown in Fig. 17, the inflation input 1542 may be provided with a bayonette mount or other means for affixing an inflati n device.

Figs. 16 and 19 show relative air flow during deflation (Fig. 16) and inflation (Fig. 19) shown by arrows 161 and 191 respectively. It can also be seen that during inflation the stiffener 1545 is configured in such a way as to permit the diaphragm 1544 to bend towards the interior of the inflatable body and away from the valve seat 1543. This arrangement facilitates the massive flow of air at low pressure into the inflatable body, while still providing resistance to deformation of the diaphragm when it is in a closed position such as shown in Fig. 15.

What is claimed is:

1. An inflatable system, comprising:

an inflatable body having a pressure valve in fluid communication with an inflation input;

inflation means, for inflating the body with a fluid, that is removably engagable with the inflation input;

sensing means, for sensing the engagement of the inflation means with the inflation input;

control means, in communication with the sensing means and the inflation means, for automatically powering the inflation means when the sensing means senses the engagement of the inflation means; and

housing means for housing the inflation means, the sensing means, and the control means in a single assembly.

2. A system according to claim 1, wherein the control means includes means for automatically powering the inflation means until a predetermined condition is achieved.

3. A system according to claim 1, wherein

the inflation means includes a battery, an electric motor powered by the battery, and an impeller; and

the control means includes means for powering the motor for a predetermined time after the sensing means senses engagement of the inflation means.

4. A system according to claim 2, wherein

the inflation means includes a battery, an electric motor powered by the battery, and an impeller; and

the control means includes means for powering the motor for a predetermined time after the sensing means senses engagement of the inflation means.

5. A system according to claim 2, wherein

the inflation means includes a battery, an electric motor powered by the battery, and an impeller; and

the control means includes means for powering the motor until fluid pressure in the housing has reached a predetermined limit.

6. A system according to claim 1, wherein

the inflation means includes a battery, an electric motor pow red by the battery, and an impeller, the inflation means being capable of producing a fluid pressure at a maximum limit not exceeding a desired maximum fluid pressure in the body; and

the control means includes means for powering the motor until fluid flow caused by action of the impeller has substantially ceased as a result of the attainment by the inflation means of the maximum fluid pressure limit.

7. A system according to claim 2, wherein

the inflation means includes a battery, an electric motor powered by the battery, and an impeller, the inflation means being capable of producing a fluid pressure at a maximum limit not exceeding a desired maximum fluid pressure in the body; and

the control means includes means for powering the motor until fluid flow caused by action of the impeller has substantially ceased as a result of the attainment by the inflation means of the maximum fluid pressure limit.

8. A system according to claim 2, wherein the control means includes means for powering the motor for a predetermined time after the sensing means senses engagement of the inflation means.

9. A system according to claim 2, wherein the control means includes means for sensing the presence of substantial fluid flow caused by action of the impeller.

10. A system according to claim 2, wherein the inflation means is capable of producing fluid pressure at a maximum limit not exceeding a desired maximum fluid pressure in the body.

11. A system according to claim 1, wherein the sensing means includes a switch actuated by engagement of the inflation means with the inflation input.

12. An inflation device, for inflating with fluid an inflatable body that is removably engagable with the device and that has an inflation input, the device comprising:

inflation means for providing fluid for inflating the body, the inflati n means including a battery, an electric motor powered by the battery, and an impeller;

connection means for removably connecting the inflation means to the inflation input; and

housing means for housing the inflation means and the connection means in a single assembly.

13. An inflation device, for inflating with fluid an inflatable body that has an inflation input and that is removably engagable with the device in a manner that the fluid input is in substantially sealed communication with the device when engaged with it, the device comprising:

inflation means for providing fluid for inflating the body;

connection means for removably connecting the inflation means to the inflation input;

sensing means, for sensing the engagement of the inflation device with the inflation input in substantially sealed communication with the device;

control means, in communication with the sensing means and the inflation means, for automatically powering the inflation means as soon as the sensing means senses the sealing engagement of the inflation device; and

housing means for housing the inflation means, the connection means, the sensing means, and the control means in a single assembly.

14. A device according to claim 13, wherein the inflation means includes a battery, an electric motor powered by the battery, and an impeller; and

the control means includes means for powering the motor for a predetermined time after the sensing means senses engagement of the inflation device.

15. A device according to claim 13, wherein

the inflation means includes a battery, an electric motor powered by the battery, and an impeller; and

the control means includes means for powering the motor until fluid pressure in the housing has reached a predetermined limit.

16. A device according to claim 13, wherein the inflation means includes a battery, an electric motor powered by the battery, and an impeller, the inflation means being capable of producing a fluid pressure at a maximum limit not exceeding a desired maximum fluid pressure in the body.

17. A device according to claim 14, wherein the inflation means is capable of producing fluid pressure at a maximum limit not exceeding a desired maximum fluid pressure in the body.

18. A device according to claim 13, wherein the sensing means includes a switch actuated by engagement of the inflation device with the inflation input.

19. An inflation device according to claim 13, wherein the body includes a suitably configured inflation input, further comprising:

mounting means, affixed to the housing and associated with the connection means, for removably mounting the inflation means to the body at the inflation input when the inflation means is engaged with the inflation input, so that inflation of the body may be achieved without manual intervention once the inflation means has been so engaged.

20. An inflatable system, comprising:

an inflatable body having a pressure valve in fluid communication with an inflation input; and

an inflation device according to claim 12.

21. An inflatable system according to claim 20, further comprising mounting means, associated with at least one of the body and the inflation means, for removably mounting the inflation means to the inflatable body when the inflation means is engaged with the inflation input, so that inflation of the body may be achieved without manual intervention once the inflation means has been so engaged.

22. An inflatable system, comprising:

an inflatable body in fluid communication with an inflation input;

inflation means, for inflating the body with a fluid, in fluid communication with the inflation input, the inflation means including an electric motor and an impeller;

exhaust means for deflating the bladder including a valve having a stem to trigger deflation;

comfort control means, having a user input with a plurality of positions, in control communication with the inflation means and the exhaust means, for causing, in a first position of the user input, the inflation means to inflate the body and, in a second position of the user input, the exhaust means to deflate the body, such comfort control means including (i) a switch, removably incorporated in the control means to control power to the motor, that is closed in the first position and (ii) means for moving the valve stem in the second position; and

a switch housing for housing the switch, such housing being removably attachable to the comfort control means and when so attached being mechanically linked to the valve stem, so that gross motion of the housing may constitute moving the user input into the second position and local movement of the switch within the housing may constitute moving the user input into the first position.

23. An inflatable system, comprising:

an inflatable body having a one-way valve in fluid communication with an inflation input, such valve having a stem to trigger deflation;

inflation means, for inflating the body with a fluid, in fluid communication with the inflation input, the inflation means including an electric motor, an impeller and a switch;

comfort control means, having a user input with a plurality of positions, in control communication with the inflation means and the exhaust means, for, in a first position of the user input, actuating the switch to cause the inflation means to inflate the body and, in a sec nd

position of the user input, moving the stem to trigger deflation of the body.

24. A method of inflating a body, having a suitably configured inflation input, the method comprising:

(a) providing a device having

(i) inflation means for providing fluid for inflating the body;

(ii) connection means for removably connecting the inflation means to the inflation input;

(iii) sensing means, for sensing the engagement of the inflation device with the inflation input;

(iv) control means, in communication with the sensing means and the inflation means, for automatically powering the inflation means when the sensing means senses the engagement of the inflation device; and

(v) housing means for housing the inflation means, the connection means, the sensing means, and the control means in a single assembly; and

(b) engaging the device with the inflation input.

25. A method according to claim 24, wherein the sensing means includes a switch actuated by engagement of the inflation device with the inflation input.

26. A cover for an inflatable body having a lying surface and an undersurface and a foot, the cover comprising:

a first sheet of material surrounding the mattress, the sheet including a top portion substantially coextensive with the lying surface of the mattress and a bottom portion disposed on the undersurface of the mattress;

gripping means, attached at the region of the bottom portion proximate to the foot of the mattress, for gripping the end of a bedsheet that is disposed generally over the lying surface.

27. A cover according to claim 26, further comprising:

a pad disposed on the underside of the top portion and substantially coextensive therewith.

28. A cover according to claim 27, wherein the gripping means includes a retainer ring having a peripheral wall and a pair of jaws hingedly attached t the wall for gripping a portion of a bedsheet inserted into the ring.

29. A cover according to claim 28 wherein the retainer ring is made of a resilient material and the peripheral wall and the pair of jaws are formed as part of an integral structure operative to cause the jaws to open when the peripheral wall is squeezed and otherwise to cause the jaws to be closed.

30. A cover according to claim 29, further comprising a pair of retaining straps attached to the bottom portion and disposed in relation to the retainer rings in such a manner as to permit each retaining strap to be wrapped, around the circumference of a rolled up assembly of a deflated mattress disposed within the cover, and secured in the jaws of a corresponding retainer ring.

31. An inflatable support system, comprising:

an inflatable mattress housing a top portion and a bottom portion and a foot; and

gripping means, attached at the region of the bottom portion proximate to the foot of the mattress, for gripping the end of a bedsheet that is disposed generally over the mattress.

32. A system according to claim 31,further comprising:

a pad disposed in the top portion and substantially coextensive therewith.

33. A system according to claim 32, wherein the gripping means includes a retainer ring having a peripheral wall and a pair of jaws hingedly attached to the wall for gripping a portion of a bedsheet inserted into the ring.

34. A system according to claim 33, wherein the retainer ring is made of a resilient material and the peripheral wall and the pair of jaws are formed as part of an integral structure operative to cause the jaws to open when the peripheral wall is squeezed and otherwise to cause the jaws to be closed.

35. A system according to claim 34, further comprising a pair of retaining straps attached to the bottom portion and disposed in relation to the retainer rings in such a manner as to permit each retaining strap to be wrapped, around the circumference of a rolled up assembly of a deflated mattress disposed within the cover, and secured to a corresponding retainer ring.

36. An inflatable system, comprising:

an inflatable body having an interior, an exterior, a port for transfer of air between the interior and exterior and a wall separating the interior and exterior;

a flange attached to the wall proximate to the port and having a throat, defined by a rim around the perimeter thereof, the rim having interior and exterior sides and a top, the throat disposed within the port, and the flange configured in the port to require all air being transferred between the interior and exterior of the body to pass through the throat; and

an assembly for removably covering the throat, the assembly including: (i) a ring-shaped base disposed around the exterior of the rim (ii) a cap hingedly attached to the base (iii) shape means for urging the rim against the base operation at least when the cap is in a closed position, so that when the cap is in an open position, the throat is uncovered, and when the cap is in a closed position, the throat is covered by the cap.

37. A system according to claim 36, wherein the shape means is a peripheral lip attached to the cap and is so configured that when the cap is in a closed position, the lip mates with the interior of the rim, so that the flexible flange is squeezed between the lip and the base.

38. A system according to claim 36, wherein the ring-shaped base is removably disposed around the exterior of the rim.

39. A system according to claim 36, wherein the assembly includes latch means for releasably latching the cap in a closed position.

40. A system according to claim 37, wherein th latch means includes a projection n the cap and a mating receptacle for the projection on the ring.

41. A system according to claim 36, further comprising:

a valve disposed in the cap.

42. A system according to claim 36, wherein the assembly further includes a gasket disposed concentrically outside the lip, the gasket compressively meeting with the top of the rim when the cap is in a closed position.

43. A system according to claim 38, wherein the gasket is formed of flexible material presenting, to the top of the rim, in profile a convex arcuate portion thereof.

44. An inflatable support system, comprising:

an inflatable body having an interior, an exterior, and inflation input for transfer of air between the interior and exterior; and

a one-way valve, disposed between the interior and the inflation input, for controlling the transfer of air, providing a substantially hermetic seal under low pressure conditions, such valve including:

a passageway having a general circular cross section and a first end in communication with the interior and a second end in communication with the inflation input;

a circular lip, disposed peripherally in the passageway and protruding radially inward, having a first surface generally facing the interior, defining a valve seat;

a flexible circular diaphragm, having an interior surface generally facing the interior and an outer surface facing away from the interior mounted for axial movement in the passageway away from and against the valve seat in respectively open and closed positions of the valve, so that an outer annular region of the outer surface of the diaphragm engages against the valve seat in the closed position; and

a generally circular coupling defining the passageway, the coupling having an open end defining the inflation input

and a flared end, contigu us therewith, providing the circular lip, so that the (i) the coupling at the open end has a smaller internal diameter than at the flared end and (ii) the diaphragm can be pushed axially to open the valve by reaching into the open end of the coupling.

45. A support system according to claim 42, wherein the valve further includes:

a valve stem centrally mounted on the inner surface of the valve; and

a valve stem support mounted to the coupling distally from the open end thereof, to permit axial movement of the valve stem and diaphragm.

46. A support system according to claim 43, wherein the valve further includes:

a valve spring disposed in relation to the valve stem support and the diaphragm in such a manner as to urge the diaphragm into a closed position; and

a circular diaphragm stiffener disposed adjacent to the diaphragm to reduce flexing of the diaphragm except in its outer annular region.

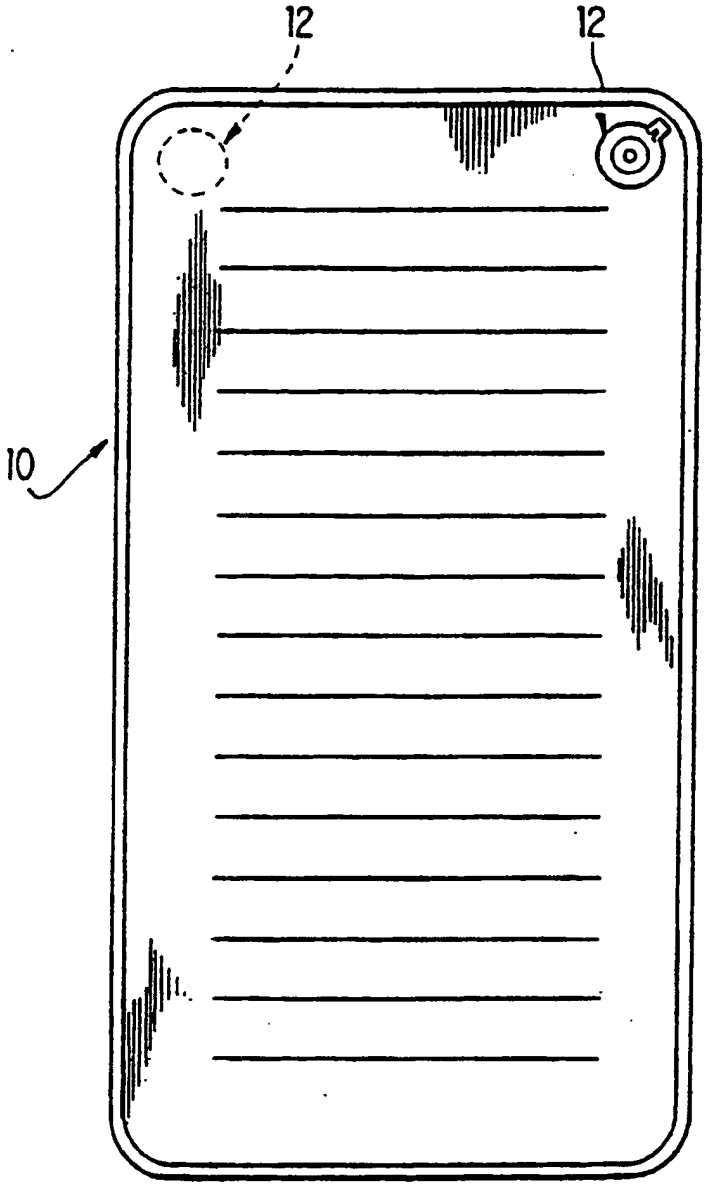

FIG. 1

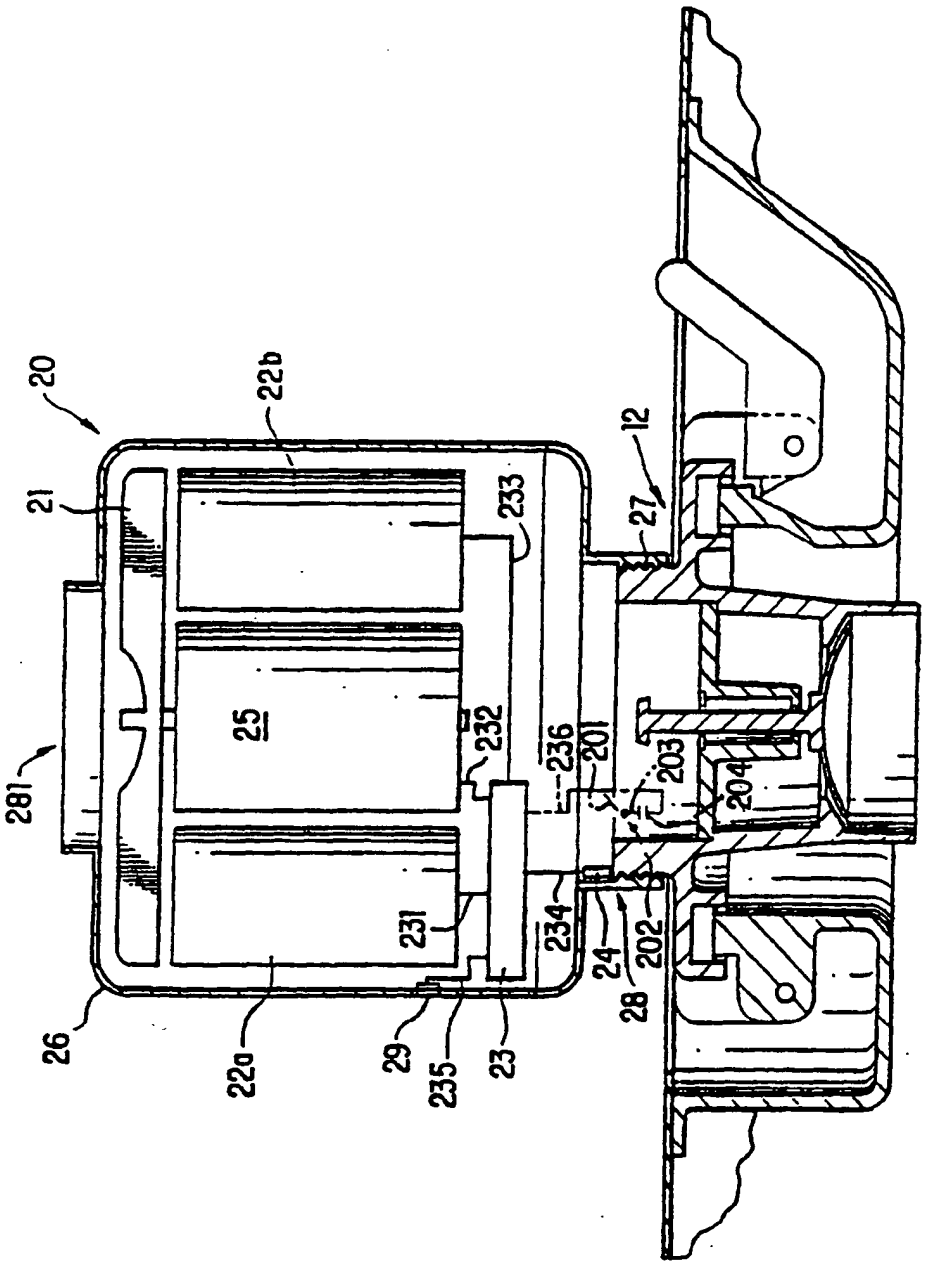
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FIG. 2

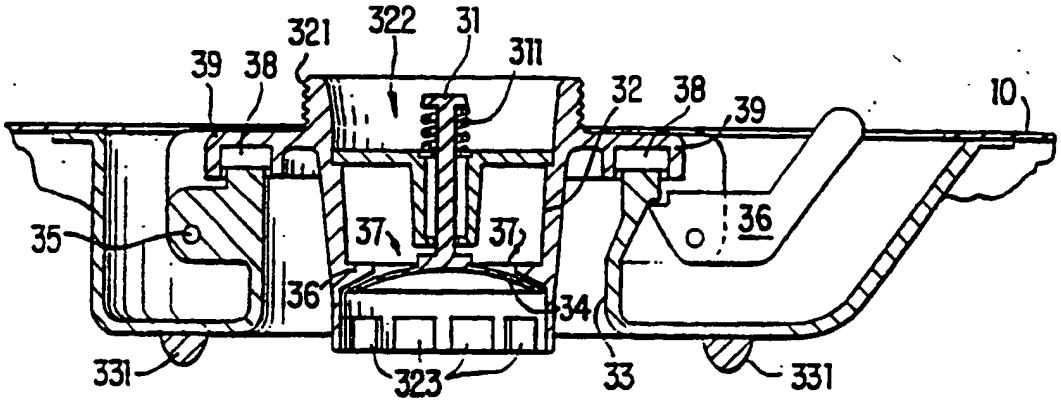
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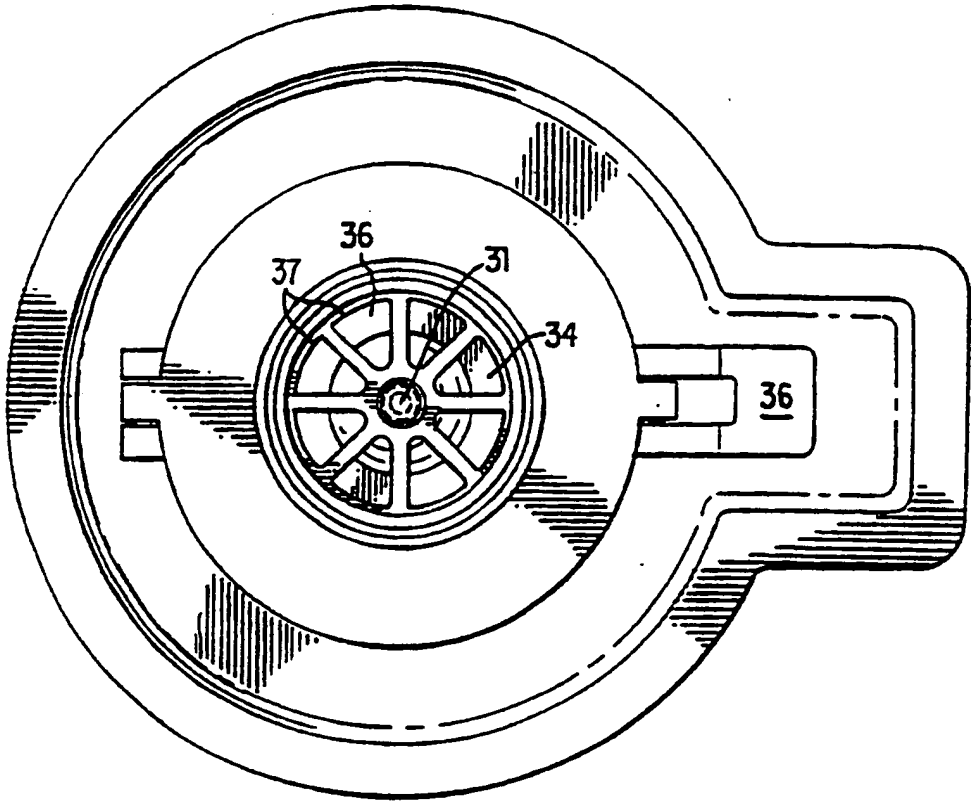
FIG. 3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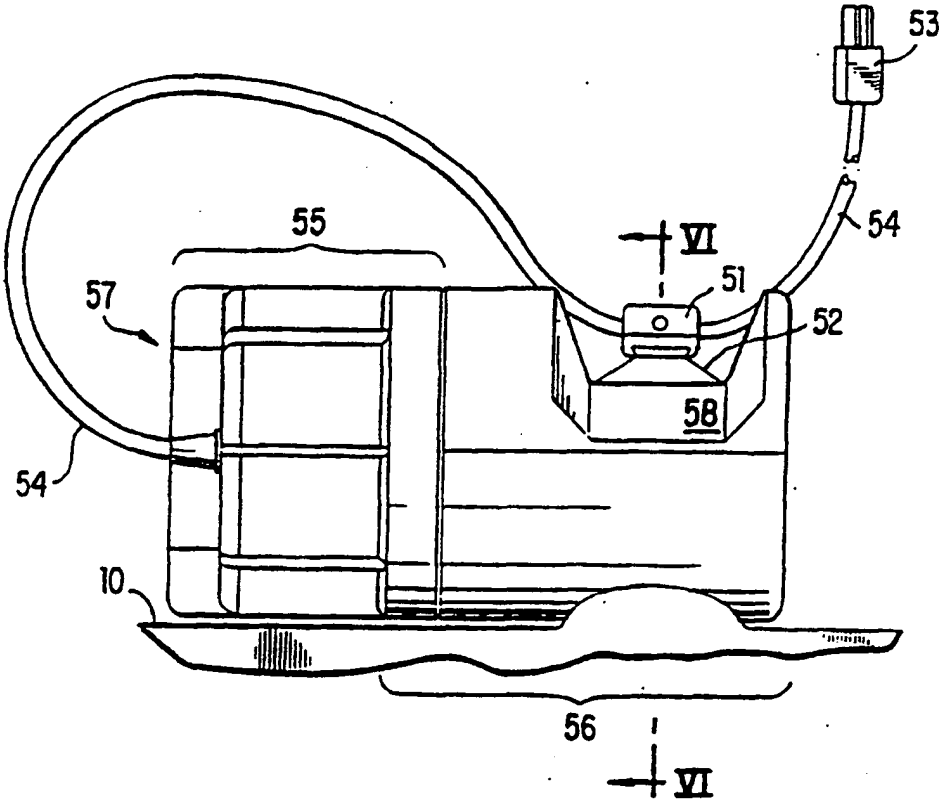


FIG. 5

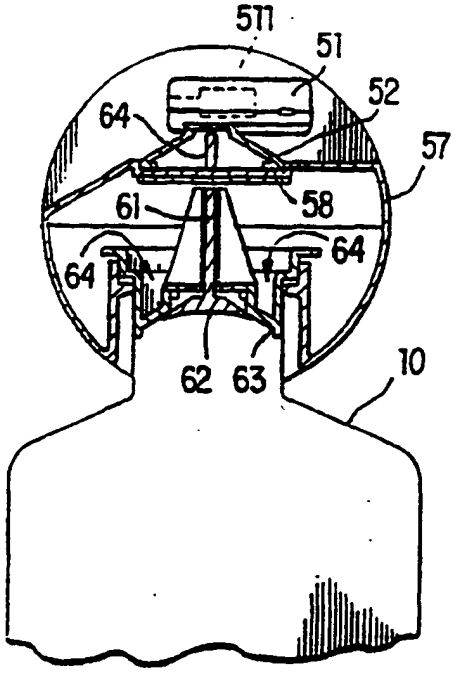


FIG. 6

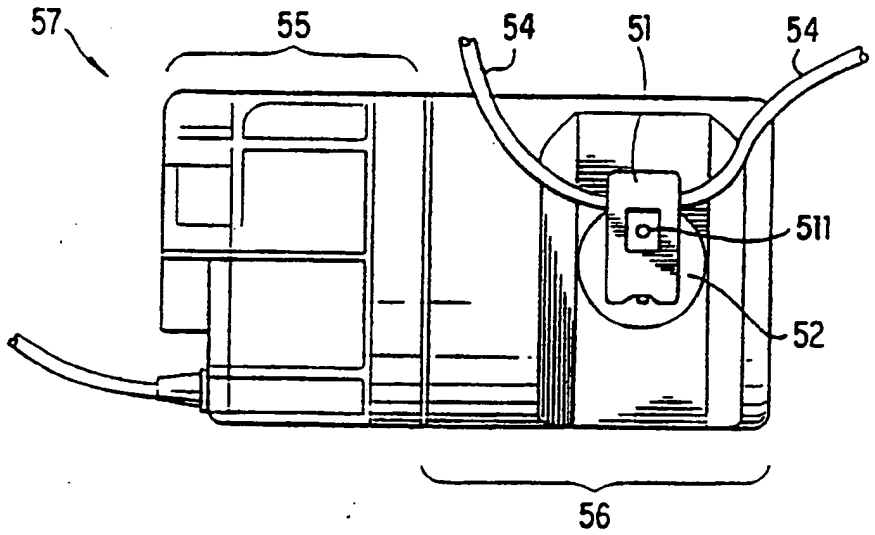


FIG. 7

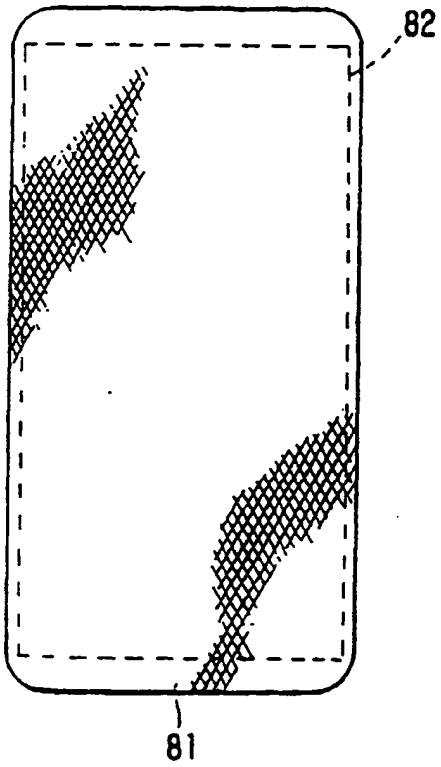


FIG. 8

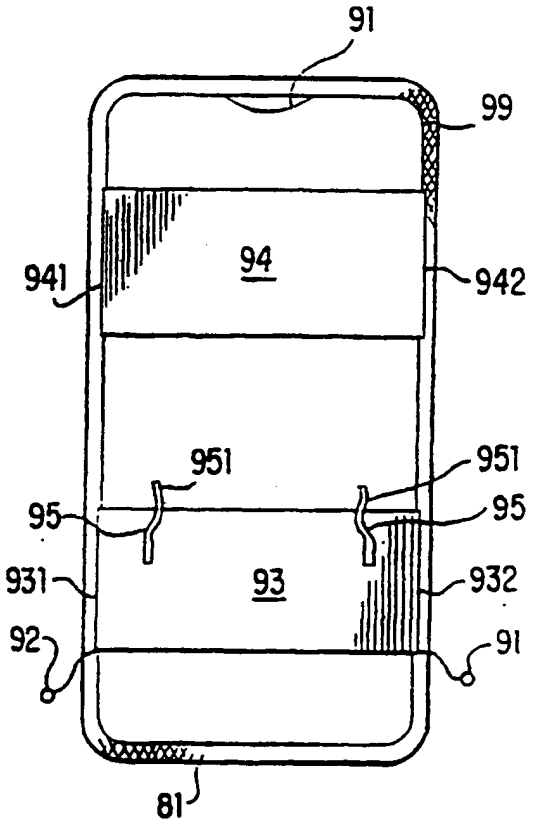


FIG. 9

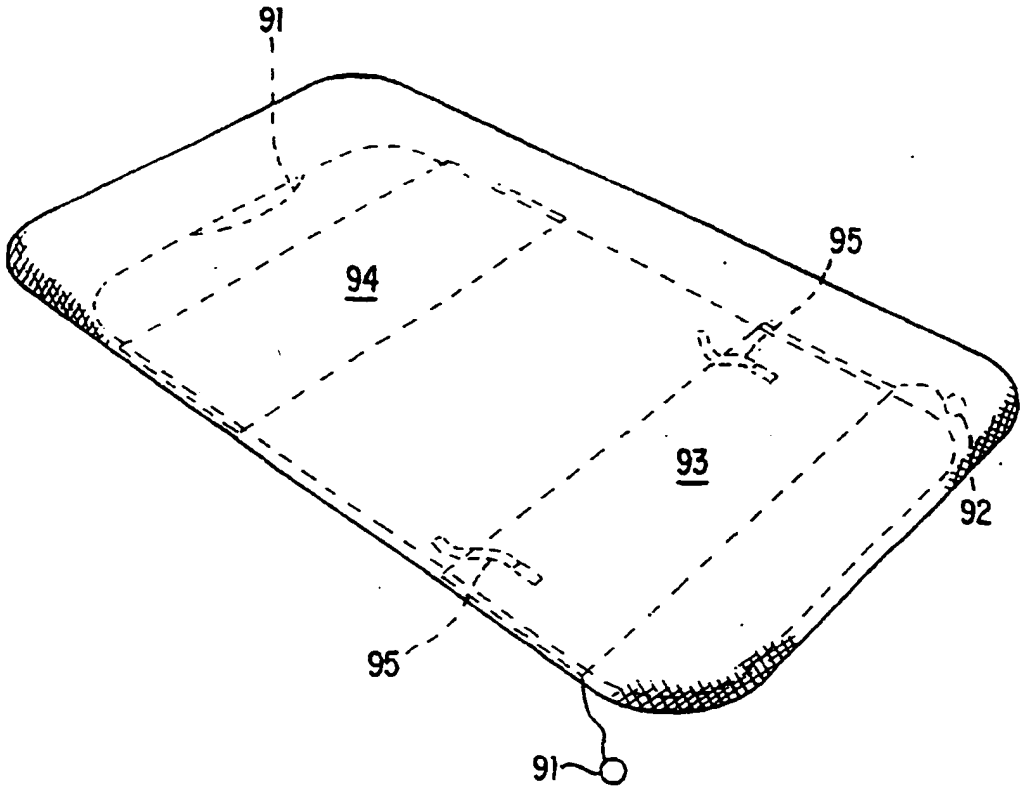


FIG. 10

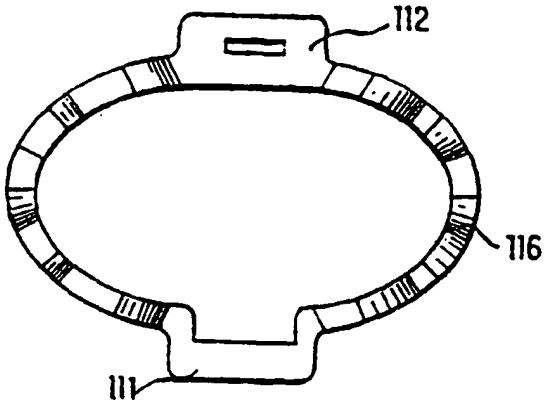


FIG. 13

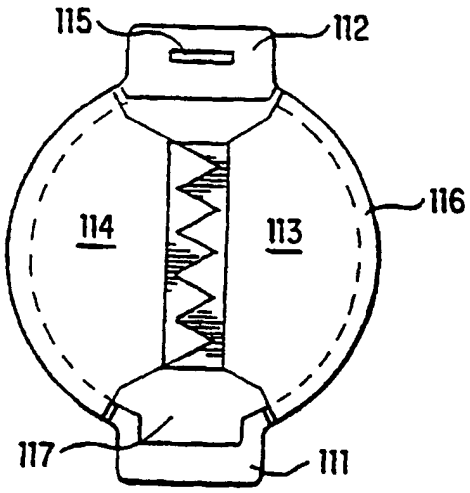


FIG. 11

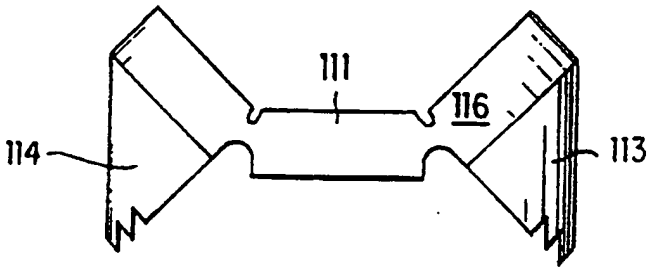
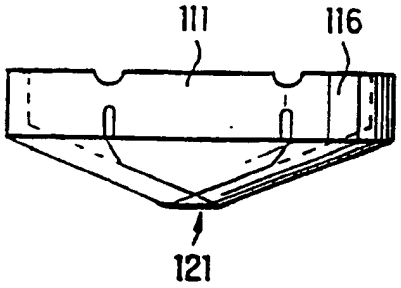


FIG. 14



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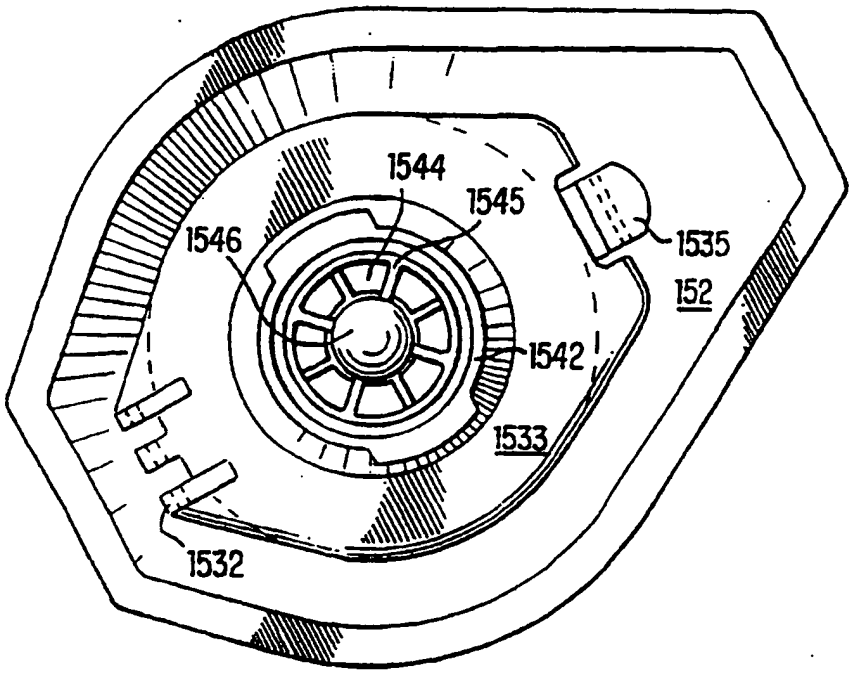
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FIG. 17

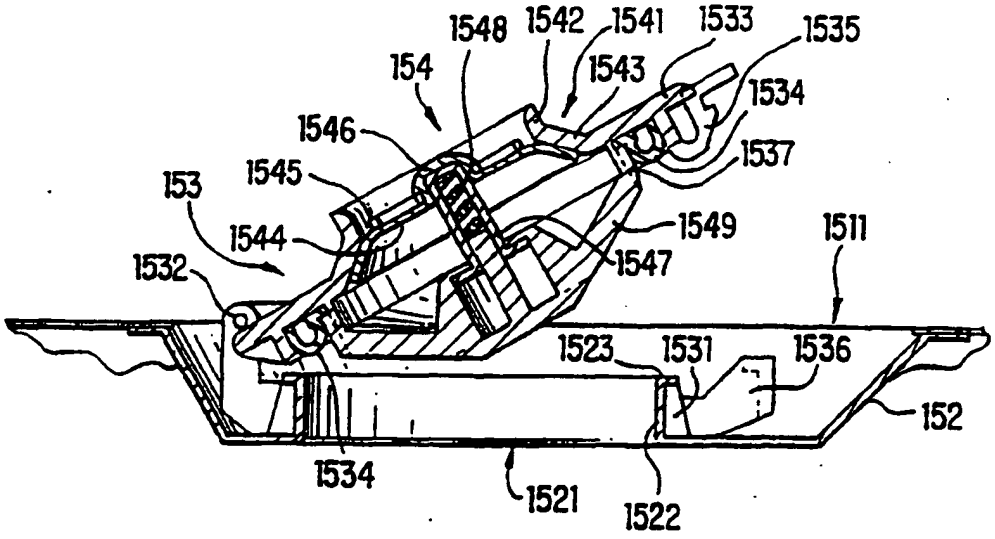
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FIG. 15

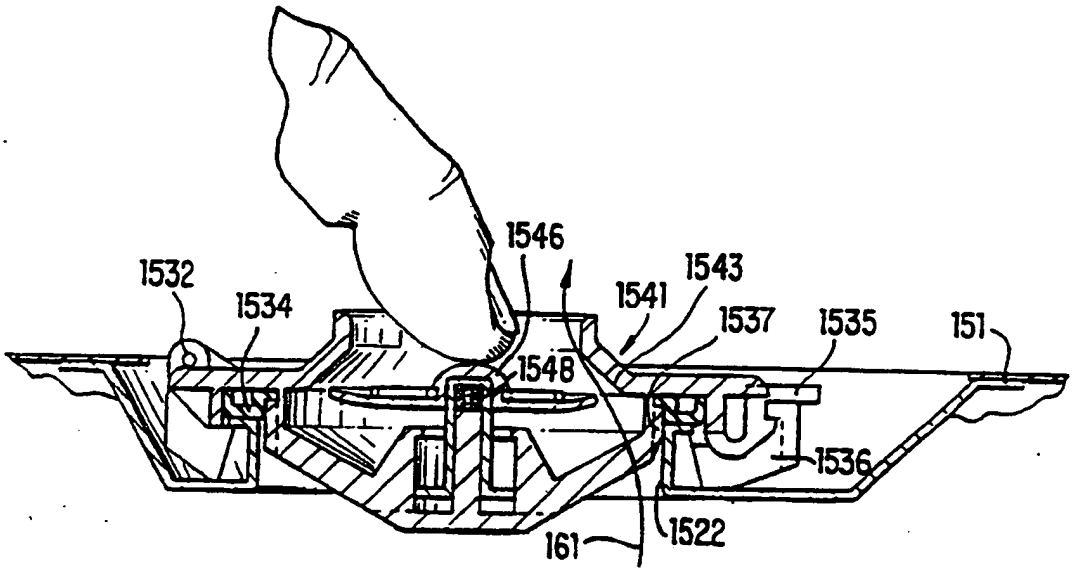
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FIG. 16

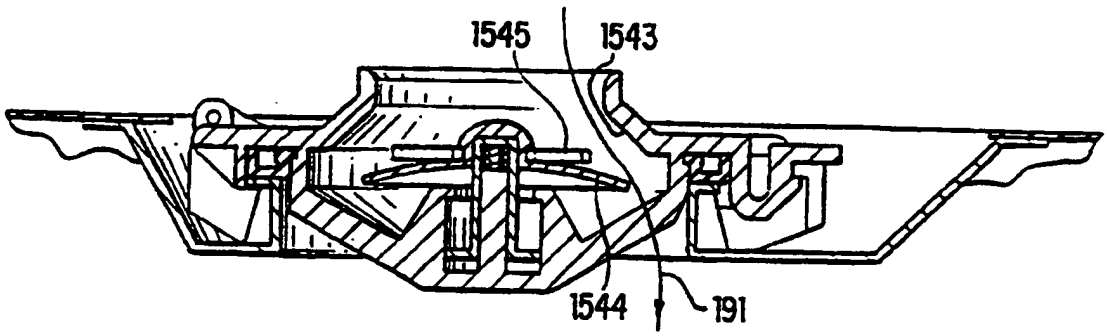
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FIG. 19

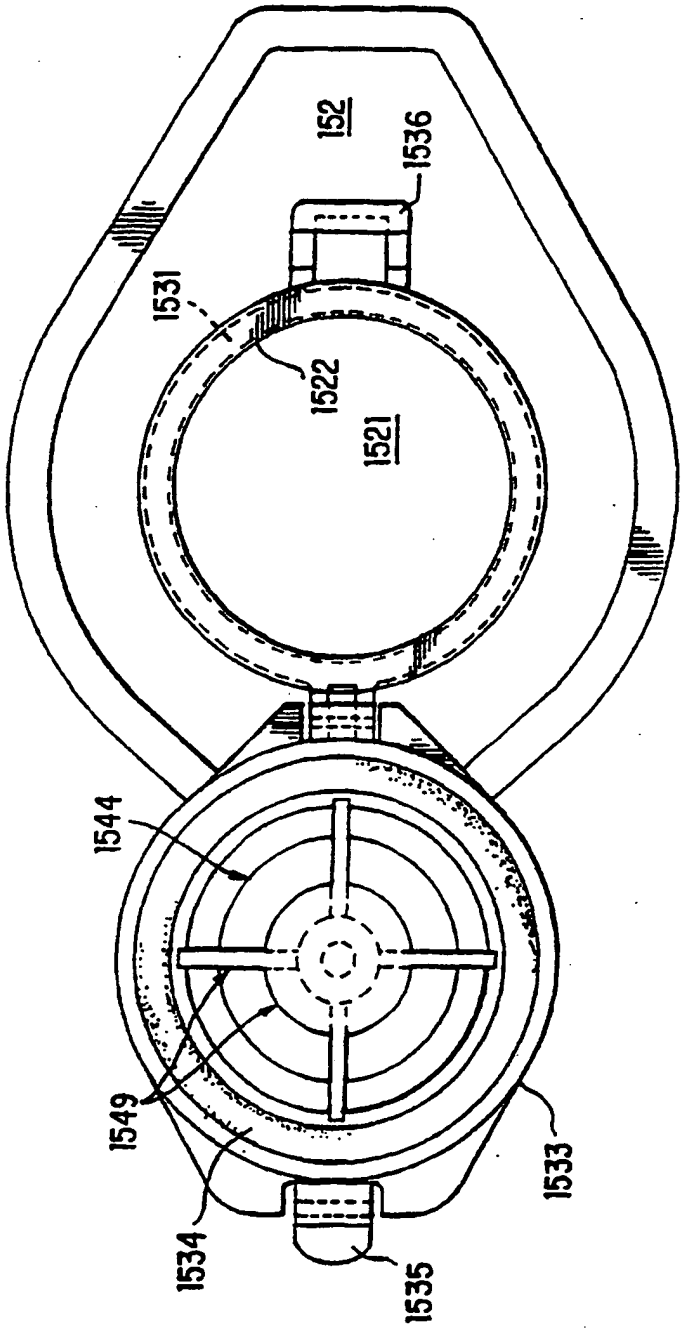

FIG. 18

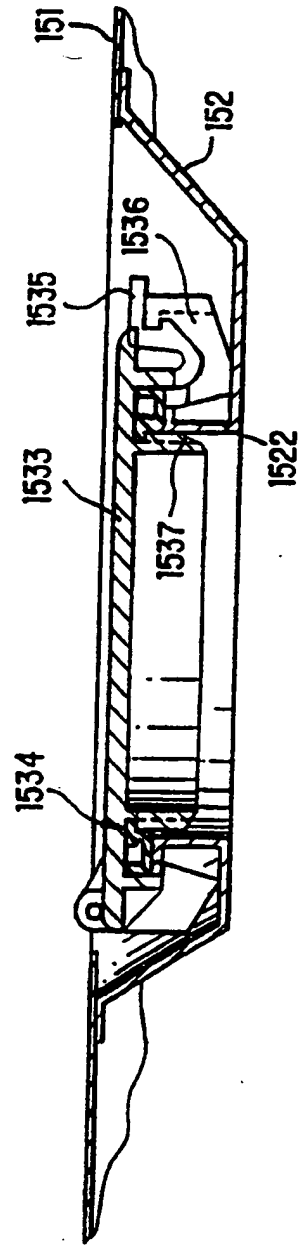

FIG. 20

INTERNATIONAL SEARCH REPORT

PCT/US92/08085

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A47C 27/00
US CL :5/453
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 5/449,453,469,,460,470,485,494,496,498, 417,38,44,411,423.7

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A, 4,678,014 (OWEN ET AL) 07 JULY 1987 Read columns 4-7.	12,20
X	US,A, 3,563,676 (COOVERT ET AL) 16 FEBRUARY 1971 Coovert shows an inflation device with motor 22, housing 12, and air outlet 60. Actuating switch 40 can be operated only by engaging device with object be inflated.	13,18,24,25
A	US,A, 4,862,533 (ADAMS, III) 05 SEPTEMBER 1989	26-43
A	US,A, 3,798,686 (GAISER) 26 MARCH 1974	26-30

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 22 FEBRUARY 1993	Date of mailing of the international search report 26 FEB 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer for MICHAEL F. TRETTEL Telephone No. (703) 308-2168

AER 000849

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/08085

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 4,317,244 (BALFOUR-RICHIE) 02 MACH 1982	26-30
A	US,A, 4,899,408 (ILLINGWORTH) 13 FEBRUARY 1990	26
A	US,A, 2,450,923 (SPIRO, JR.) 12 OCTOBER 1940	26
A	US,A, 4,579,141 (ARFF) 01 APRIL 1986	44-46
A	US,A, 4,766,628 (WALKER) 30 AUGUST 1988	44-46
A	US,A, 3,995,653 (MACKEL ET AL) 07 DECEMBER 1976	36-39
A	US,A, 1,451,131 (ALLNUT) 10 APRIL 1923	36
A	US,A, 4,982,466 (HIGGINS ET AL) 08 JANUARY 1991	1
A	US,A, 5,068,933 (SEXTON) 03 DECEMBER 1991	1,22,23
A	US,A, 4,829,616 (WALKER) 16 MAY 1989	1,22,23
A	US,A, 4,734,017 (LEVIN) 29 MARCH 1988	12-16
A	US,A, 4,080,105 (LONNELL) 21 MARCH 1978	12-16
A	US,A, 4,977,633 (CHAFFEE) 18 DECEMBER 1990	1,22,23,26, 27,31,32
A	US,A, 4,897,890 (WALKER) 06 FEBRUARY 1990	1,22,23

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/08085

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

I. Group I, claims 1-25 and 36-46, drawn to an inflatable body support and valve assembly for the same, classified in Class 5, subclass 453.

II. Group II, claims 26-35, drawn to a cover for an inflatable body support, classified in class 5, subclass 496.

and it considers that the international application does not comply with the requirement s of unity of invention (Rules 13.1,13.2 and 13.3) for the reasons indicated below:

There is no common special technical feature between Group I and Group II. At best these inventions are subcombinations usable together in a single combination. However, each Group relates to an invention which has utility by itself.